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Collembola diversity in Portuguese autochthonous and allochthonous forests

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The authors studied the effects of reafforestation by *Eucalyptus globulus* on the edaphic Collembola populations occurring in *E. globulus* plantations and in coppices of *Pinus pinaster*. This study revealed that the populations from *Eucalyptus* are richer in species, namely in exclusive species, than those from pine forest. Even so, among the species inhabiting the two biotopes, the number of preferential species is higher in pine forest, as well as the total number of individuals.

1. Introduction

This paper presents the first results of a research project entitled "Fluctuation of biodiversity patterns following reafforestation with indigenous versus exotic tree species". The aim is to determine the relationships between edaphic Collembola from a *Pinus pinaster* Aiton forest and the changes induced by reafforestation with *Eucalyptus globulus* Labill.

In Portugal the area planted with *E. globulus* has been increasing during the last years, now reaching about 450 000 ha. In these plantations there is a marked decrease in the amount of litter on the forest floor, possibly leading to a change in the fertility. Research on the Collembolan fauna of *E. globulus* plantations and other forests (*Pinus pinaster*, *Quercus suber* Linné) has revealed that the communities in allochthonous plantations are poorer in exclusive and preferential species than those from natural forests (Figueiredo et al. 1985, Gama et al. 1989, 1991).

2. Study area, material and methods

Sampling was carried out in Lousã, 20 km east of Coimbra, in May 1991, in coppices of *Pinus pinaster* (aged about 48 years) and *Eucalyptus globulus* plantations (at the end of the 2nd rotation, aged about 28 years). The pine forest has shrub and herbaceous layers composed of *Calluna vulgaris* (L.) Hull, *Lithodora prostrata* (Loisel.) Griseb, *Andryala integrifolia* Linné and *Polygala microphyla* Linné. In *Eucalyptus* plantations the shrub layer is very poor, having only some specimens of *Calluna vulgaris* and *Ulex europaeus* Linné.

Both biotopes are at 550–600 m in altitude, the pine forest being on a slope of 15% and the eucalyptus plantation on one of 25%; their expositions are NW 49° and NW 51°, respectively.

In each biotope, one sampling quadrat (8 × 8 m) was selected regarding some criteria of homogeneity of soil type, vegetation, topography and hydrology. This quadrat was then divided into 16 squares of 2 × 2 m and in the middle of each a litter sample (surface area 125 cm^2; volume 250 cm^3) and a soil sample (surface area 25 cm^2; volume 250 cm^3) were taken, making a total of 32 samples. In addition, a pitfall trap was placed in each square for one week.

For each sample the physical parameters measured were soil temperature (at a depth of 10 cm), wet weight, dry weight and pH. Soil animals were extracted by means of Berlese-Tullgren funnels. Collembola were sorted and identified to species level.

3. Results

The *Pinus pinaster* plantation was represented by 4267 individuals and 30 taxa, in contrast to 2520 specimens and 41 taxa in the *Eucalyptus* plantation (Table 1). Among these, 18 occur exclusively in eucalyptus. *Folsomia quadrioculata* is the dominant species in litter, but among the other exclusive species, 11 are represented only by 5 or fewer specimens.

In contrast to the *Eucalyptus* plantations, pine forests have only 7 exclusive species (Table 1). The dominant species is *Xenylla schillei* with 1915 individuals (1801 in litter, 90 in soil and 24 in pitfall traps). It also appears in *Eucalyptus* plantations but less abundantly, with only 115 specimens.

From the species common to the two biotopes, *Ceratophysella armata* and *Lepidocyrtus lignorum* are much more abundant in *Eucalyptus* than in pine forest, specially the first one which is the dominant species in *Eucalyptus* soil samples, representing 92% of the total number of individuals

Table 1. Total abundance of Collembolan species in pine forest and *Eucalyptus* plantation collected by litter sampling, soil sampling, and pitfall traps.

		Pine			Eucalyptus	
	Litter	Soil	Pitfall	Litter	Soil	Pitfall
Ceratophysella armata (Nicolet, 1841)	11	45	–	127	501	–
Ceratophysella engadinensis (Gisin, 1949)	–	–	–	1	12	–
Xenylla schillei Börner, 1903	1801	90	24	70	44	1
Microgastrura duodecimoculata Stach, 1922	3	13		4	6	–
Pseudachorutes palmiensis Börner, 1903	1	–	–	1	–	1
Pseudachorutella asigillata (Börner, 1901)	39	2	–	2	–	–
Pseudachorudina bougisi Delamare, 1951	50	13	–	35	3	–
Anurida pusilla Gama, 1964	–	–	–	8	8	–
Anurida sp. (0+0 eyes)	–	–	–	–	5	–
Rusekella gamae Arbea et Yordana, 1991	–	–	–	17	10	–
Micranurida pygmaea Börner, 1901	30	1	–	13	5	–
Odontella lamellifera (Axelson, 1903)	2	1	–	–	–	–
Bilobella aurantiaca (Caroli, 1910)	16	–	–	14	12	–
Deutonura atlantica Deharveng, 1982	1	–	–	1	–	–
Neanura sp.	–	–	–	2	3	–
Onychiurus portucalensis Gama, 1964	–	–	–	8	19	–
Onychiurus sp.	–	–	–	–	1	–
Mesaphorura macrochaeta Rusek, 1976	53	–	–	4	–	–
Mesaphorura yosii (Rusek, 1967)	3	–	–	–	–	–
Mesaphorura sp.	11	13	–	6	3	–
Paratullbergia callipygos (Börner, 1902)	–	–	–	5	36	–
Tetracanthella proxima Steiner, 1955	9	475	–	125	365	1
Folsomia quadrioculata (Tullberg, 1871)	–	–	–	469	90	–
Folsomia candida (Willem, 1902)	–	–	–	2	–	–
Proisotoma minuta (Tullberg, 1871)	364	105	–	26	9	–
Cryptopygus scapelliferus (Gisin, 1955)	94	24	–	5	2	–
Isotomiella minor (Schäffer, 1896)	149	65	–	3	8	–
Pseudisotoma sensibilis (Tullberg, 1876)	128	47	–	115	39	–
Sinella sp. (4+4 eyes)	–	–	–	4	3	–
Entomobrya albocincta (Templeton, 1835)	10	6	6	–	–	–
Entomobrya multifasciata (Tullberg, 1871)	77	8	12	5	3	–
Heteromurus major (Moniez, 1889)	58	5	3	43	4	4
Lepidocyrtus violaceus Lubbock, 1873	–	–	–	5	–	–
Lepidocyrtus lignorum (Fabricius, 1775)	1	1	12	30	3	63
Lepidocyrtus lusitanicus Gama, 1964	–	–	–	1	–	–
Pseudosinella picta (Börner, 1903)	2	–	–	11	3	–
Pseudosinella sp. (4+4 eyes)	–	–	–	3	1	–
Pseudosinella sp. (0+0 eyes)	–	1	–	–	–	–
Tomocerus longicornis (Müller, 1776)	–	–	–	1	–	1
Tomocerus flavescens (Tullberg, 1871)	–	–	–	1	–	–
Tomocerus vulgaris (Tullberg, 1871)	2	–	–	–	–	–
Cyphoderus albinus Nicolet, 1842	1	–	–	3	–	–
Entomobryidae juv.	298	15	55	46	18	2
Megalothorax minimus Willem, 1900	4	–	–	5	6	–
Arrhopalites mauli Delamare et Bassot, 1957	–	–	–	–	2	–
Sminthurinus bimaculatus (Axelson, 1902)	2	3	1	–	–	–
Caprainea bremondi (Delamare et Bassot, 1957)	1	–	–	–	–	–
Dicyrtomina sp.	–	–	–	1	–	1
Total	3221	933	113	1222	1224	74

against 8% in pine forest. *Tetracanthella proxima* occurs in both biotopes with a similar abundance (approx. 50%). It is the dominant species in soil samples in pine forest (475 specimens), but is also well represented in *Eucalyptus* (365 individuals in soil samples and 125 in litter).

Even so, some other common species are much more abundant in pine forest than in the eucalyptus stations: *X. schillei* (representing 94% of the total number of individuals of this species), *Pseudachorutella asigillata* (95%), *Pseudachorudina bougisi* (62%), *Micranurida pygmaea* (63%), *Mesaphorura macrochaeta* (93%), *Mesaphorura* sp. (73%), *Proisotoma minuta* (93%), *Cryptopygus scapelliferus* (94%), *Isotomiella minor* (95%) and *Entomobrya multifasciata* (92%).

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